Solution by the PROPOSER.

$r(a^2\sin^2\theta+b^2\cos^2\theta)=2ab^2\cos\theta$ or $u=\dfrac{a^2\sin^2\theta+b^2\cos^2\theta}{2ab^2\cos\theta}$ is polar equation to the ellipse with vertex as pole.

$F=h^2u^2\left(\dfrac{d^2u}{d\theta^2}+u\right)$ is the force required, h being an undetermined constant.

$$\frac{d^2u}{d\theta^2}=\frac{(a^2-b^2)\cos^4\theta+a^2\sin^2\theta+a^2}{2ab^2\cos^3\theta}; \qquad \frac{d^2u}{d\theta^2}+u=\frac{a}{b^2\cos^3\theta}.$$

$$\therefore\ F=\frac{ah^2u^2}{b^2\cos^3\theta}=\frac{ah^2(a^2\sin^2\theta+b^2\cos^2\theta)^2}{4a^2b^6\cos^5\theta},$$

$$\therefore\ F=\frac{a^3h^2}{4b^6\cos^5\theta}-\frac{h^2a(a^2-b^2)}{2b^6\cos^3\theta}+\frac{(a^2-b^2)^2h^2}{4ab^6\cos\theta}.$$

Also solved by *J. SCHEFFER*.

99. Proposed by F. P. MATZ, Sc. D., Ph. D., Professor of Mathematics and Astronomy in Defiance College, Defiance, Ohio.

Through the zenith of an observer at the sea-coast in north latitude $\varphi=40°$, a "cat's-tail cloud," height $h=10$ miles, extends northeast until it touches the horizon. How far from the observer is the *advance-end* of the cloud? What is the length of the cloud measured from the end specified to the observer's zenith?

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

Regarding the earth as a perfect sphere of radius 3963 miles, and disregarding the observer's height, the distance and length required will be the same for any latitude.

Let C be the center of the earth, O the position of the observer, Z his zenith, and BOA the diameter of the visible horizon.

$OA=\sqrt{(CA^2-CO^2)}=\sqrt{[(3973)^2-(3963)^2]}=281.71$ miles, the distance of advance end from observer.

$\cos OCA=\frac{3963}{3973}=.997483.\quad \angle OCA=4°\ 4'.$

$\therefore\ ZA=(4\frac{1}{15}\pi\times7946)/360=281.99$ miles, length of cloud.

100. Proposed by F. P. MATZ, Sc. D., Ph. D., Professor of Mathematics and Astronomy in Defiance College, Defiance, O.

Determine the maximum value of $(\varphi-\varphi')$, if given electric currents C and C' produce deflections φ and φ' in a tangent galvanometer, so that $\tan\varphi/\tan\varphi'=C/C'$.

Solution by GEORGE R. DEAN, Professor of Mathematics, Missouri State School of Mines and Metallurgy, Rolla, Mo.

We have $C'\tan\varphi=C\tan\varphi'$, $u=\varphi-\varphi'$.

Differentiating, we must have for a maximum or minimum, $C'\sec^2\varphi d\varphi = C\sec^2\varphi' d\varphi'$. $d\varphi = d\varphi'$.

Eliminating the differentials, $C'\sec^2\varphi = C\sec^2\varphi'$.

Solving this and the given relation for φ, we find

$$\tan^2\varphi = \frac{C^2 - CC'}{C'^2 - CC'} = -\frac{C}{C'}.$$

But $\frac{-C}{C'} = -\frac{\tan\varphi}{\tan\varphi'}$. Hence $\tan\varphi\tan\varphi' = -1$.

This shows that $\varphi - \varphi' = 90^\circ$.

Also solved by *H. C. WHITAKER*, and *G. B. M. ZERR*.

PROBLEMS FOR SOLUTION.

ALGEBRA.

145. Proposed by JOHN M. COLAW, A. M., Monterey, Va.

Solve the equations:

$$\begin{aligned} &x+y+z+u+w=1,\\ &ax+by+cz+du+ew=h,\\ &a^2x+b^2y+c^2z+d^2u+e^2w=h^2,\\ &a^3x+b^3y+c^3z+d^3u+e^3w=h^3,\\ &a^4x+b^4y+c^4z+d^4u+e^4w=h^4. \end{aligned}$$

146. Proposed by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

Solve by a short original method, if possible:

$$\begin{aligned} &x/a+y/b+c/z=P \ldots.(1),\\ &x/a+b/y+z/c=Q \ldots.(2),\\ &a/x+y/b+z/c=R \ldots.(3). \end{aligned}$$

GEOMETRY.

180. Proposed by R. TUCKER, M. A.

ABC is a triangle; A', B', C' are the images of A, B, C with respect to BC, CA, AB. The circum-circle ABC cuts $A'BC$ (say) in K (on $A'B$), M (on $A'C$), and AK, AM, AA' cut BC in P, R, Q, respectively. Prove that (1) the orthocenters of the associated triangles lie on circle ABC; (2) triangle AKM has its sides parallel to and equal twice the sides of the pedal triangle of ABC. and is also equal triangle formed by the above-named orthocenters; (3) $CP.a=b^2$,